

THE WEATHER AND CIRCULATION OF JANUARY 1971

Amplification Over the United States With a Change in the Temperature Regime

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1. MEAN CIRCULATION

Major features of the monthly mean circulation during January included a split westerly pattern over the Pacific and a single broad band of westerlies over the Atlantic (figs. 1 and 2). This was a contrast to the December

regime (Stark 1971) in which the Atlantic circulation had a split westerly blocking pattern while the Pacific circulation was one broad band of westerlies from Asia to North America. The change of circulation was accompanied by progression of some troughs and ridges and the formation of others.

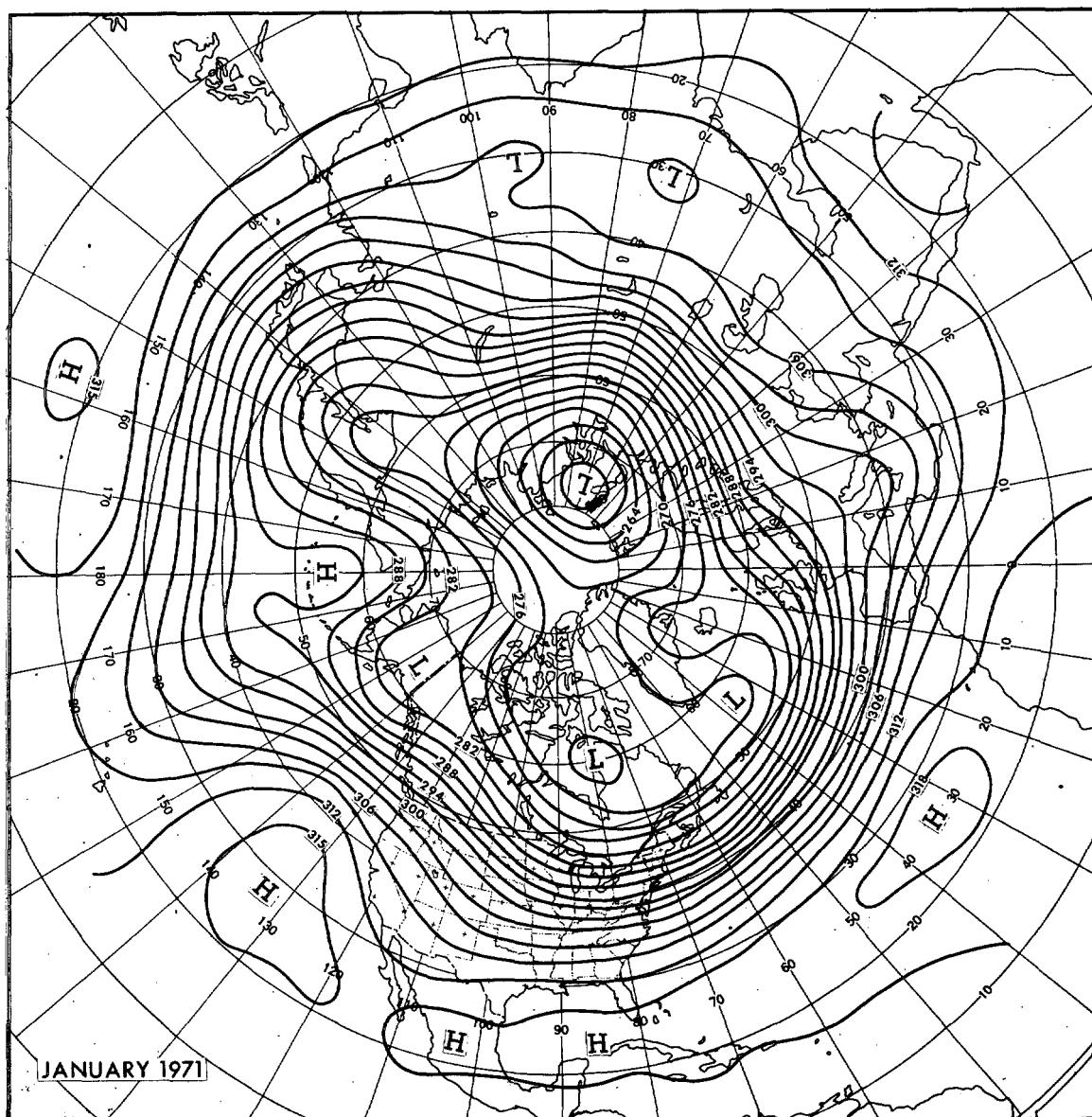


FIGURE 1.—Mean 700-mb contours (dekameters) for January 1971.

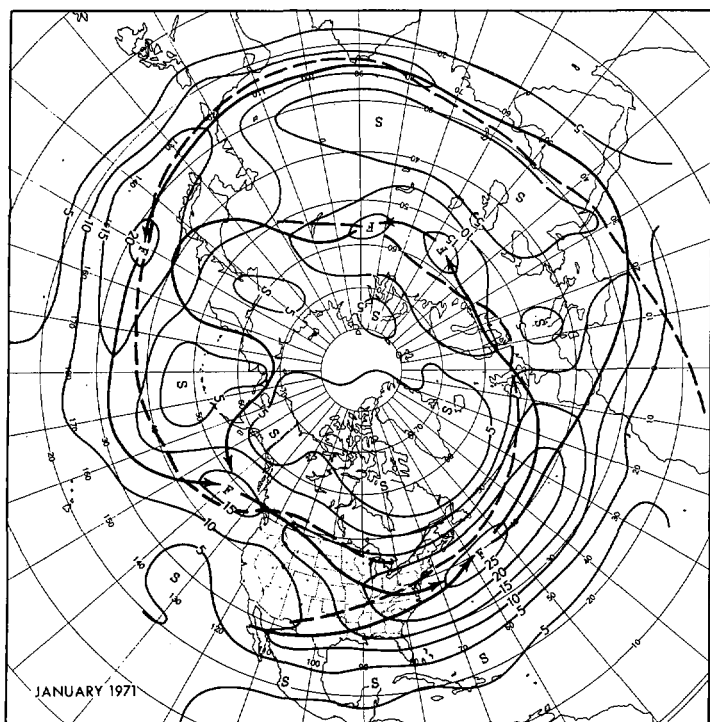


FIGURE 2.—Mean 700-mb isotachs (meters per second) for January 1971. Solid arrows indicate the observed axis of maximum wind speed, and the dashed lines indicate the normal axes.

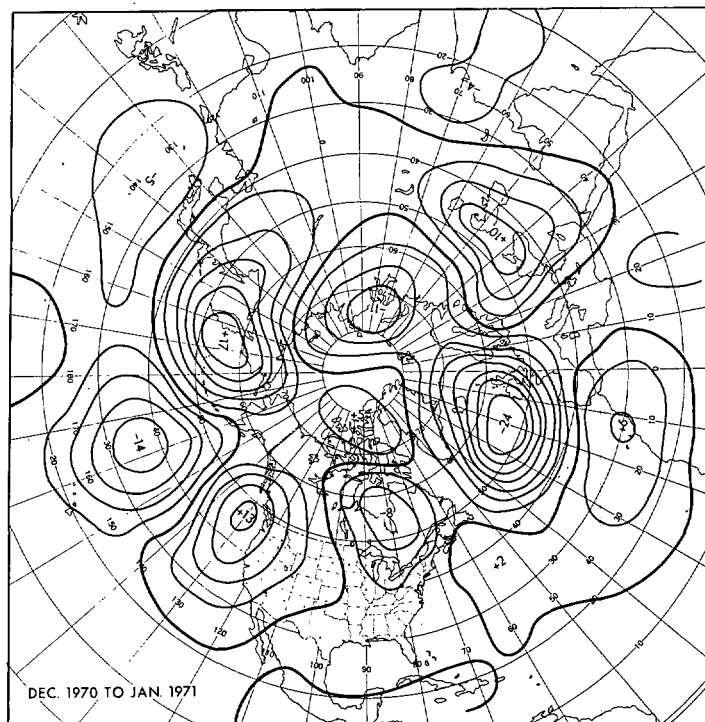


FIGURE 3.—Mean 700-mb height anomaly change (dekameters) from December 1970 to January 1971.

The strong December ridge north of the Hawaiian Islands moved toward the mainland in January, and a new trough formed north of Hawaii as the Pacific circulation became more complex. At the same time, a new mean ridge formed over the Bering Sea, completing the strong blocking pattern of the central Pacific. Northerly flow east of the Bering Sea ridge persisted in the northern part of the West Coast trough of December, but the southern portion of this trough moved eastward to form part of the broad cyclonic circulation from the Mississippi Valley eastward across the Atlantic. The mean 700-mb flow between 30° and 50°N almost paralleled latitude circles from the eastern United States to the European coast this month.

The largest change in the mean circulation occurred in the area west of the British Isles where 700-mb height anomalies averaged 240 m lower than during December (fig. 3) and where frequent intense storminess replaced predominantly anticyclonic conditions. In the western Atlantic, monthly changes were quite small, and the 100-m negative height anomaly center near Newfoundland (fig. 4) was very similar to December conditions; however, 700-mb heights lowered noticeably over the eastern United States.

The mean Low over the Arctic Ocean near Novaya Zemlya moved very little but deepened sharply, with 700-mb heights reaching a maximum of 160 m below normal, while the mean height anomaly center southward

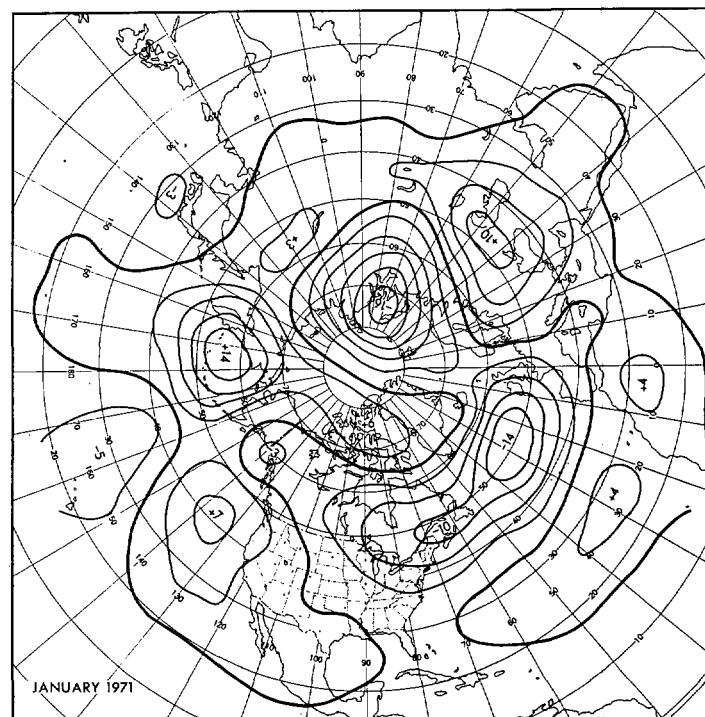


FIGURE 4.—Departure from normal of the mean 700-mb height (dekameters) for January 1971.

near the Black and Caspian Seas rose to 100 m above normal. Height anomalies west of Greenland also rose as the blocking December ridge near the British Isles appeared to split, with the northern part retrograding and the

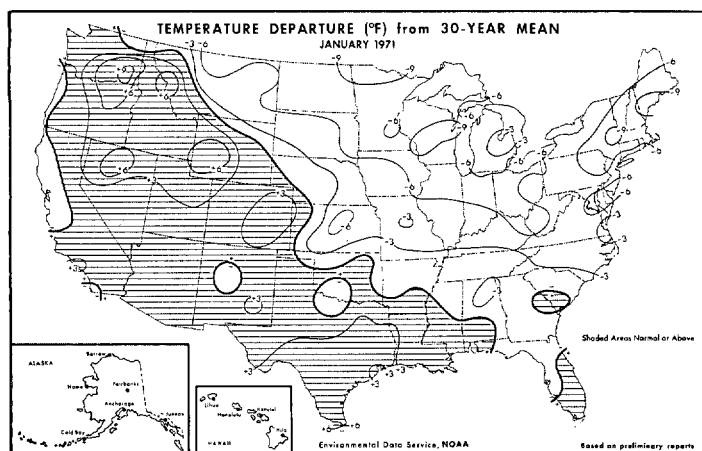


FIGURE 5.—Departure from normal of average surface temperature ($^{\circ}\text{F}$) for January 1971 (from Environmental Data Service and Statistical Reporting Service 1971).

southern part advancing into Europe. Cyclonic activity increased in the Mediterranean as the trough from the west coast of Africa moved over that area.

Over Asia, the anomalous and absolute 700-mb flow increased in higher latitudes and decreased in lower latitudes during January. The normally divided bands of 700-mb winds were near their usual positions (fig. 2), even though their intensities were abnormal (fig. 4). The effect downstream was a deepening of the coastal trough near southern Japan and Korea, while a filling but sharp trough persisted over the Sea of Okhotsk.

2. MONTHLY TEMPERATURE

The amplified flow resulting from the advancing eastern Pacific ridge and deepening trough over eastern North America (figs. 1 and 2) caused a basic change in the temperature pattern in the United States. Most sections west of the Rocky Mountains warmed owing to frequent incursions of mild Pacific air, and cooling occurred in the East as the increasing northerly flow brought more cold continental air southward than during December. Areas of least change were the Northern and Southern Plains and the extreme Northeast. The Northern Plains and most of New England as well as New York State had below-normal temperatures in December (Stark 1971), and these areas continued abnormally cold. The Southern Plains were relatively warm in December and also in January.

Temperatures averaged 3° to 6°F above normal over large sections of the West and the Southern Plains, with a small area in the Northwest reporting temperatures 9° above normal (fig. 5). In the East and Northern Plains, larger areas were affected by the more extreme temperatures; but the range of the negative temperature anomalies was about the same as the positive anomalies in the West.

Although many daily temperature records were set in January, very few monthly records were established. The

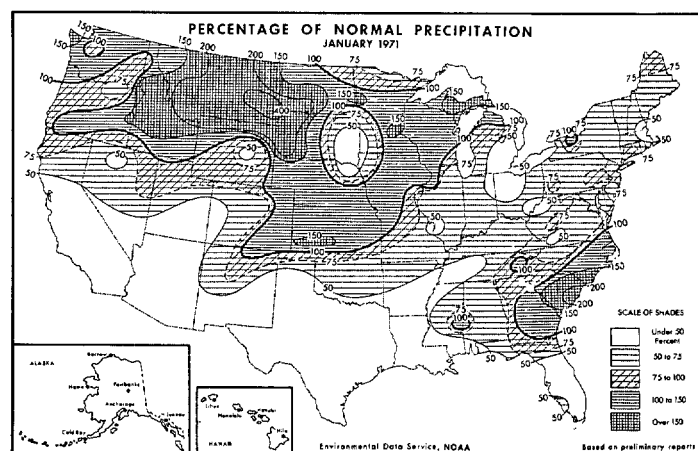


FIGURE 6.—Percentage of normal precipitation for January 1971 (from Environmental Data Service and Statistical Reporting Service 1971).

persistent coldness in New England caused record or near-record low monthly temperatures in some localities. Concord, N.H., where an average of 12.5°F was 8.7° below normal, reported that only January of 1970 was colder. Portland, Maine, with an average of 12.2°F that was 9.6° below normal, reported the coldest month of record.

All of Alaska was colder than normal this January, and interior Alaska was extremely cold. Fairbanks with a monthly average temperature of -31.7°F had the coldest month of record. For 18 days beginning on the 14th, temperatures remained below -22°F at Fairbanks, thus giving the longest stretch of such cold weather of record.

3. MONTHLY PRECIPITATION

Northerly anomalous flow over most of the Nation (fig. 4) resulted in below-normal precipitation for most of the country outside the Northern Plains and the Upper Mississippi Valley (fig. 6). The unusually heavy precipitation (mostly in the form of snow) in Montana and adjacent States was associated with frequent low-pressure centers moving along the boundary between the cold and warm air. The heavier than normal precipitation in the Southeast was related to Lows steered by the southward-displaced "jet" through that area (fig. 2). The normal axis of the southern branch of westerlies through the East coincides almost precisely with the tongue of relatively light precipitation through Arkansas and Tennessee, and the observed axis this year passed through the area of relatively heavy precipitation in the Southeast. The heavier than normal precipitation in the Far Northwest was associated with slightly stronger than normal westerlies.

Stampede Pass, Wash., reported 23.29 in. of precipitation (snowfall of 149.5 in.), which was 11.26 in. above normal, during the month. Havre, Mont., reported a

record January precipitation of 2.33 in. and a record snowfall for any month of 41.4 in. Houghton Lake, Mich., with 27.5 in. and Marquette, Mich., with 52.6 in. reported the heaviest January snowfall of record. For Marquette, the amount was the second heaviest for any month since 1885. Saulte Ste. Marie, Mich., had 50.5 in. of snowfall, which was the second highest in January for that station. In contrast to these reports, the area from Louisiana through Texas and the Southwest was extremely dry. Corpus Christi, Tex., reported the driest January of record; and Port Arthur, Tex., had the driest January at the present observing location. Austin, Tex., reported that November and December 1970 and January 1971 were the driest three consecutive months of record. This was the driest January at Austin since 1904.

The large-amplitude blocking pattern in the central Pacific (figs. 1 and 4) caused a general absence of trade winds in the Hawaiian Islands during January. Disturbances on the polar front gave generally rainy and cloudy weather, and all stations from which reports were received had above-normal rainfall. Lihue with a total of 11.82 in. had more than twice its normal rainfall, and 13.66 in. at Kahulue was more than four times the usual January amount. A tornado struck Kailua Kona on January 28, causing approximately \$2 million in damage.

4. VARIABILITY WITHIN THE MONTH

The first days of January were marked by generally below-normal temperatures in the East and West and above-normal temperatures in the central part of the country (not shown). This temperature pattern changed abruptly during the week of January 4–10 as amplification of the mean flow over North America occurred (figs. 7A and 7B). Most of the Western and Central States turned colder while the East Coast warmed (fig. 7C). The Southwest was the center of the coldest air relative to the normal. A number of minimum temperature records were established this week; some of the more significant are listed in table 1. El Paso, Tex., experienced the longest period of subfreezing temperature of record from the 3d to the 7th of January. Phoenix, Ariz., had a record 6 days in which minimum temperatures were 28°F or lower. Other extremely low minimum temperatures included –39°F at Hawley Lake, Ariz., and –42°F at Frazier, Colo. Rock Springs, Wyo., experienced a maximum temperature of only –18°F on Tuesday afternoon of this week. Considerable freeze damage to crops occurred in the Southwest with this cold period.

The giant storm that developed in the Southwest on the second day of the month and preceded the plunge of cold air into the area gave widespread precipitation to the Southwest and the central part of the country (fig. 8). Very heavy snowfall and blizzard conditions developed as this storm approached the Great Lakes. Waterloo, Iowa, reported a blizzard of “classic proportions” and 15.8 in. of snow. Lacrosse, Wis., and Moline, Ill., reported record

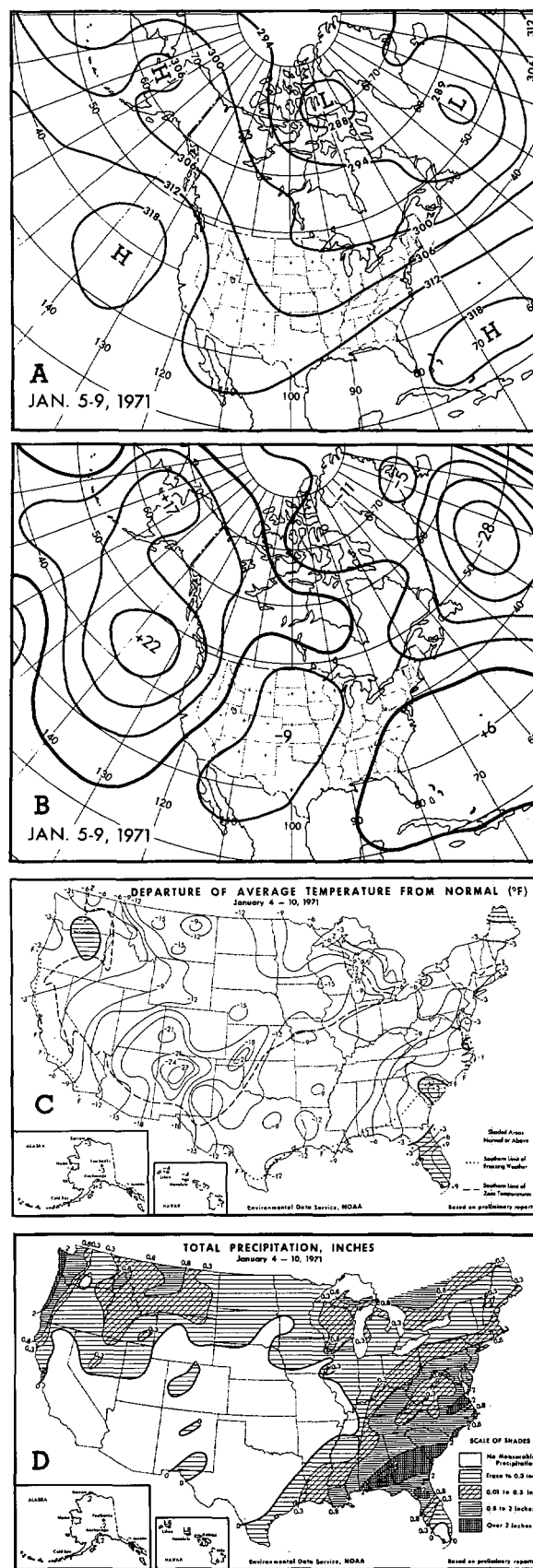


FIGURE 7.—(A) mean 700-mb contours and (B) departure from normal (both in dekameters) for Jan. 5–9, 1971; (C) departure of average surface temperature from normal (°F) and (D) total precipitation (inches) for week of Jan. 4–10, 1971 (from Environmental Data Service and Statistical Reporting Service 1971).

TABLE 1.—Record high and low temperatures during January 1971

Station	Temperature (°F)	Date	Remarks
Flagstaff, Ariz.	66	30	Record maximum for January
Phoenix, Ariz.	88	19	Do.
Winslow, Ariz.	-15	6	Alltime record minimum
Winslow, Ariz.	75	20	Record maximum for January
Yuma, Ariz.	88	19	Do.
Long Beach, Calif.	89	18	Do.
Los Angeles, Calif.	95	18	Do.
Denver, Colo.	78	20	Do.
Winnemucca, Nev.	68	18	Do.
Albuquerque, N. Mex.	-17	7	Alltime record minimum
Albany, N.Y.	-28	19	Do.
Sexton Summit, Oreg.	65	31	Record maximum for January
Corpus Christi, Tex.	91	30	Do.
San Antonio, Tex.	89	30	Do.
Salt Lake City, Utah	61	31	Do.
Yakima, Wash.	68	30	Do.
Casper, Wyo.	60	30	Do.

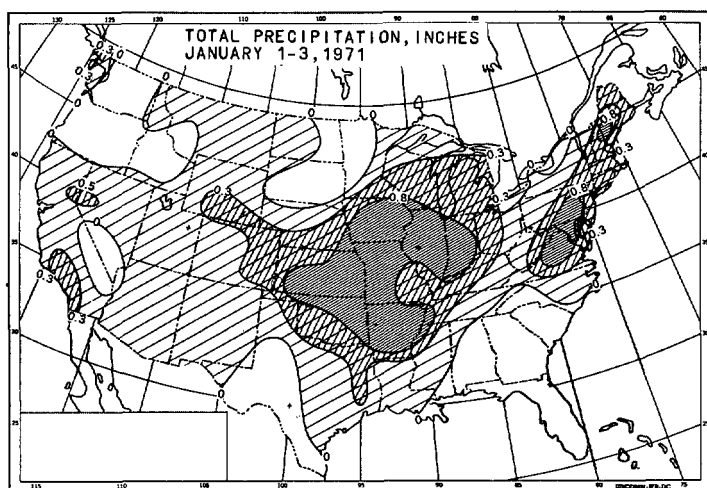


FIGURE 8.—Total precipitation (inches) for Jan. 1-3, 1971.

24-hr snowfalls of 16 and 16.4 in., respectively. After the passage of this storm, snow depths varied from 12 to 17 in. from the Colorado Rockies across Nebraska and Iowa to northern Illinois. Freezing rain and sleet fell just south of the snowbelt as the storm passed. Rain and scattered thunderstorms occurred farther south. Two separate storms late in the week of January 4-10 caused the heavy precipitation shown in figure 7D in the Southeast and the Northwest.

Temporary deamplification associated with a progressing wave train over North America occurred the second full week of January. The resulting westerly flow over the United States (figs. 9A and 9B) brought rapid warming in the West and South (fig. 9C). The strong upper level ridge over Alaska forced arctic air southward far enough to keep the Northern States east of the Rockies very cold. Lower minimum temperatures in the North were highlighted by -33°F at Cutbank, Mont., -35°

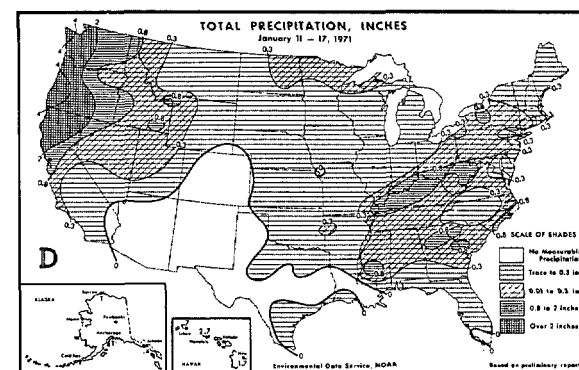
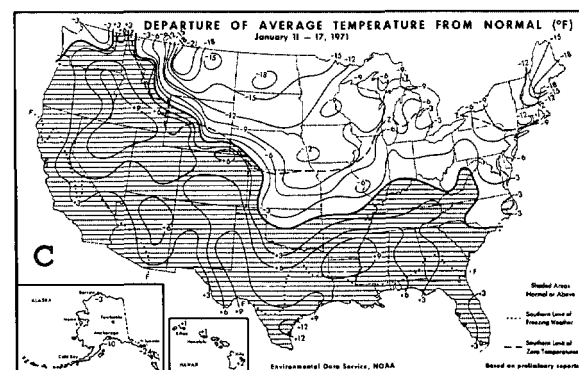
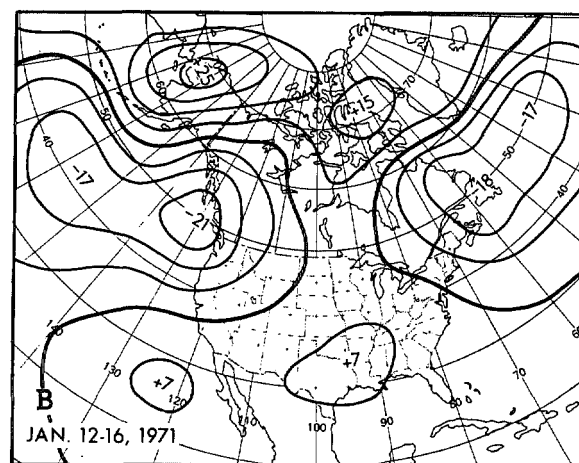
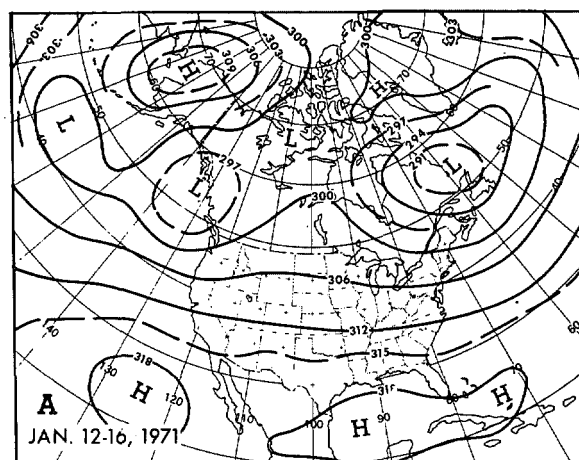


FIGURE 9.—Same as figure 7, (A) and (B) for Jan. 12-16, 1971; (C) and (D) for week of Jan. 11-17, 1971.

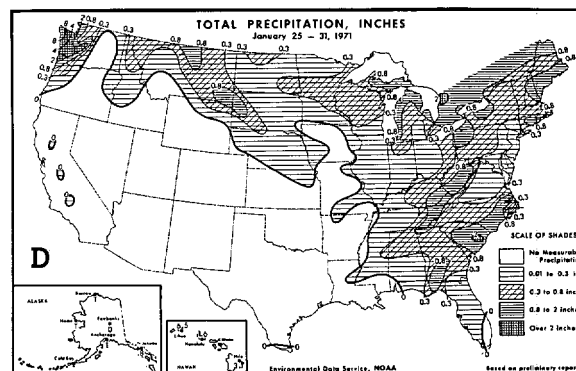
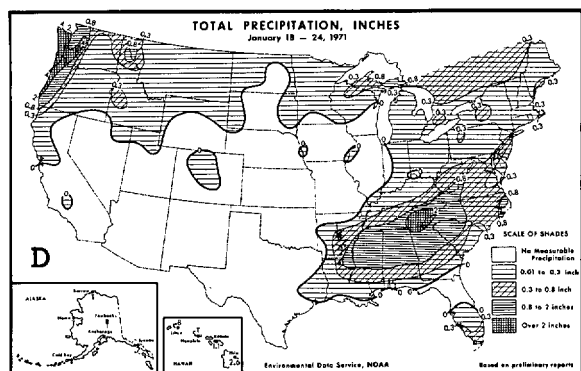
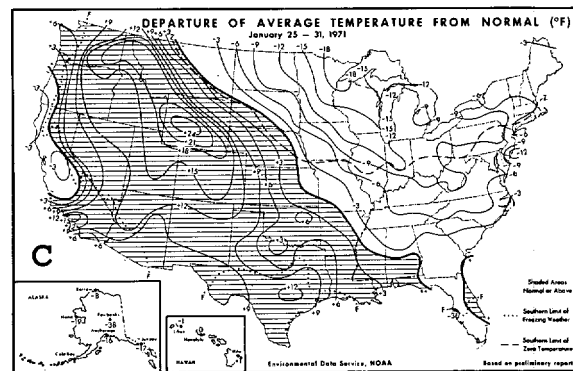
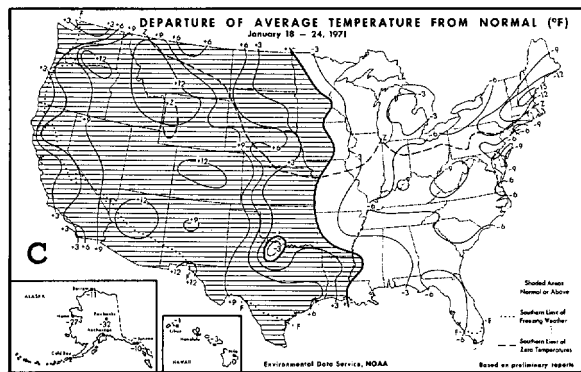
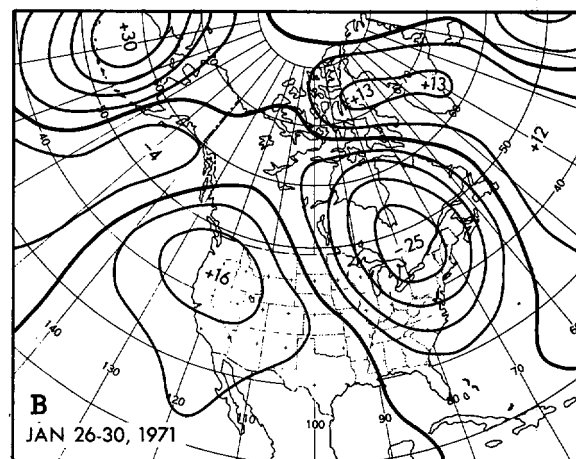
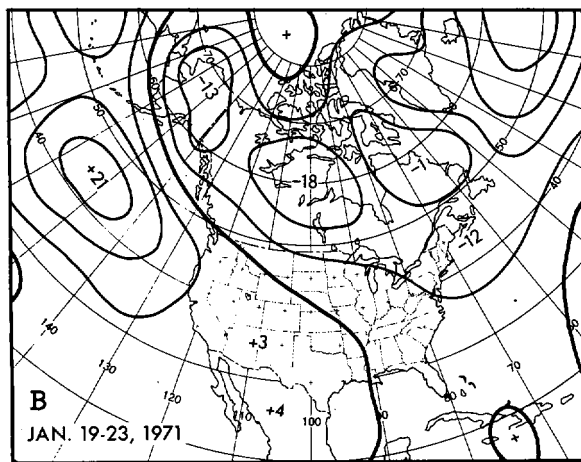
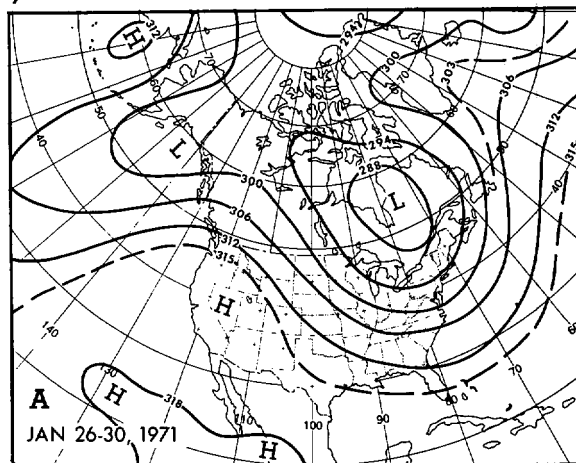
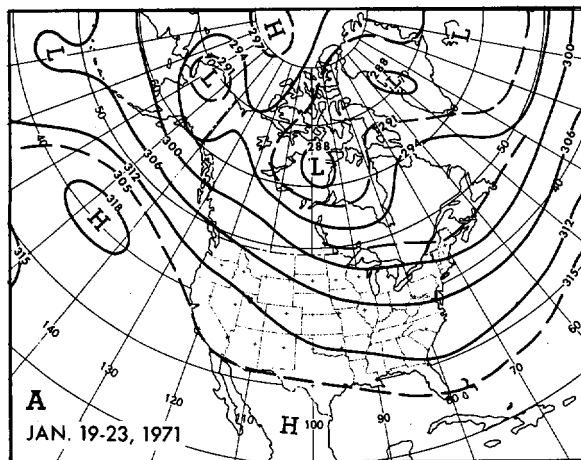


FIGURE 10.—Same as figure 7, (A) and (B) for Jan. 19-23, 1971; (C) and (D) for week of Jan. 18-24, 1971.

FIGURE 11.—Same as figure 7, (A) and (B) for Jan. 26-30, 1971; (C) and (D) for week of Jan. 25-31, 1971.

at Bismarck, N. Dak., and -39° at Stillwater Reservoir, N.Y.

Frequent cyclogenesis off the west coast associated with a long fetch of southwesterly winds from the Hawaiian area and cold arctic air forced into the Gulf of Alaska by the strong ridge over Alaska caused heavy precipitation in the West (fig. 9D). Most of the precipitation in the eastern half of the country fell along the boundary between the cold and warm air without major storm development.

Progression of the Gulf of Alaska Low into central Canada during the third week of January while the Alaskan ridge was replaced by a new mean Low, along with a retrograding but building ridge in the eastern Pacific (figs. 10A and 10B), spread mild Pacific air into the Northern Plains (fig. 10C). Many sections of the Southwest had record maximum temperatures this week (table 1). All of the States east of the Mississippi River averaged colder than normal as a result of a deepening broad trough near the coast. Moderate to heavy frost and freeze damage to truck crops was reported in Florida. Even Miami was affected by the cold. A record daily minimum of 35°F was measured there on the 20th.

Since the main storm track veered far north into Canada with the mean upper level Low, most of the country was quite dry this week (fig. 10D). The heavy precipitation in the Northwest occurred mostly early in the week as the major Low moved across the Rockies into Canada. The precipitation in the East was again generally frontal, for no major storms developed in the East.

Amplification was repeated over the United States in the final week of January, as the Pacific ridge progressed into the West and the trough in the East deepened (figs. 11A and 11B). The western ridge was accompanied by large positive temperature anomalies from the Rockies

westward except for parts of California (fig. 11C). The major cause of the relative coolness in the California Valley was persistent stratus that held day-time temperatures well below normal. Many daily maximum temperature records were established in this period from Texas to the State of Washington (table 1). The center of the cold air, both in the anomalous and absolute sense, was in the Minnesota and Wisconsin area. No significant low temperature records were noted in the reports received, but some daily minimum temperature records were broken.

Subsidence associated with the strong progressing ridge caused an almost complete absence of precipitation in the warmer part of the Nation during the last 7 days of January (fig. 11D). The major exception being the Northwest Coast where up to 8 in. of precipitation fell. Two major storms contributed to the precipitation that was confined mainly to the relatively cold part of the country. Both storms caused blizzard conditions and heavy snowfall in some areas, but the first storm became massive in size and affected a much larger area, mainly in the Great Lakes region and the Northeast. Wind gusts to 50 to 70 mi/hr were common on the 26th. Automobile travel became impossible in some areas and extremely hazardous in many others.

REFERENCES

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- Stark, L. P., "The Weather and Circulation of December 1970—Cold and Wet in the North and Far West With Mild, Relatively Dry Conditions Elsewhere," *Monthly Weather Review*, Vol. 99, No. 3, Mar. 1971, pp. 250-254.